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PROBLEMS FOR SOLUTION.

SEND ALL COMMUNICATIONS ABOUT PROBLEMS TO B. F. FINKEL, Springfield, Mo.

ALGEBRA.

483. Proposed by C. R. DUNCAN, Amherst College.Prove or disprove the following theorem: An infinite series, $A_1 + A_2 + A_3 + \cdots + A_n + \cdots$ is convergent or divergent according as

$$\lim_{n \rightarrow \infty} \frac{A_n}{1 - \frac{A_n}{A_{n-1}}} = 0 \quad \text{or} \quad \neq 0.$$

484. Proposed by E. V. HUNTINGTON, Cambridge, Massachusetts.

Show that

$$\frac{\frac{1}{m^2} - \frac{k_1}{(m+1)^2} + \frac{k_2}{(m+2)^2} - \cdots + \frac{(-1)^k}{(m+k)^2}}{\frac{1}{m} - \frac{k_1}{m+1} + \frac{k_2}{m+2} - \cdots + \frac{(-1)^k}{m+k}} = \frac{1}{m} + \frac{1}{m+1} + \frac{1}{m+2} + \cdots + \frac{1}{m+k}$$

for all positive integral values of m and k . Here

$$k_1 = \frac{k}{1}, \quad k_2 = \frac{k(k-1)}{1 \cdot 2}, \quad k_3 = \frac{k(k-1)(k-2)}{1 \cdot 2 \cdot 3}, \quad \text{etc.}$$

This equation was suggested to the proposer by a professor of chemistry who wishes to make use of the equation, if correct, in an actual problem in bacteriology.

GEOMETRY.

516. Proposed by R. M. MATHEWS, Riverside, California.

Through the edges of a trihedral angle planes are passed orthogonal to the opposite faces. Prove them coaxial.

517. Proposed by R. P. BAKER, University of Iowa.The coordinates of the vertices of a regular icosahedron can be expressed rationally in terms of $\frac{\sqrt{5}-1}{4}$ and $\sqrt{\frac{5+\sqrt{5}}{8}}$, that is, $\cos \frac{2\pi}{5}$ and $\sin \frac{2\pi}{5}$. Prove (1) that the cosine only is sufficient; (2) that the irrationalities cannot be reduced further. (The theorem that they cannot be rational is proved in books on crystal theory.)

CALCULUS.

431. Proposed by J. W. LASLEY, University of North Carolina.

Explain Bertrand's fallacy:

$$\int_{x=0}^{x=1} \int_{y=0}^{y=1} \frac{x^2 - y^2}{(x^2 + y^2)^2} dy dx = \int_{y=0}^{y=1} \int_{x=0}^{x=1} \frac{(x^2 - y^2)}{(x^2 + y^2)^2} dx dy;$$

$$\frac{1}{4}\pi = -\frac{1}{4}\pi, \quad 1 = -1.$$

432. Proposed by R. P. BAKER, University of Iowa.

The expressions

$$x^{i+1} \left(\frac{1}{x} \frac{d}{dx} \right)^i \left(\frac{c_1 e^{ax} + c_2 e^{-ax}}{x} \right)$$

and

$$x^{-(i+1)} \left(x^i \frac{d}{dx} \right)^i \left(\frac{c_1 e^{ax} + c_2 e^{-ax}}{x^{2i-1}} \right)$$

are formally equivalent for every integral value of i .